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ABSTRACT

More Ph.D. mathematicians are going into teaching positions with relatively little training or experience in college teaching. This document reports on a project in which Ph.D. mathematicians were given teaching internships at St. Olaf College, Northfield, Minnesota, in order to develop teaching skills, promote research activity, facilitate teacher socialization of the interns, develop future leaders in the profession, and enhance the viability of using mentors to acclimate new teaching faculty. The first section of the report provides background information and a rationale for the project. The second section describes the hiring of interns, the training of mentors, and project activities. The third section presents the project goals. The fourth section indicates present and predicted project outcomes. The project directors conclude that: (1) the program is attractive to Ph.D. mathematicians; (2) the postdoctoral program is effective in creating master classroom teachers; (3) interns gain professional know-how that, in turn, invigorates the veteran faculty; (4) effective teaching entails a complicated symbiosis of personality, technique, philosophy, and understanding of mathematics; and (5) release time built into the program is critical to its success. Three appendices contain recruiting materials, consultants' reports, and conference materials. (MDH)

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ED 367 533

Teaching Postdoctoral Positions in Mathematics

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Northfield, MN 55057

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Grant Award:

Year 1	48,640
Year 2	89,533
Year 3	89,010

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Summary of Project

In January 1988 St. Olaf College established a mentored teaching postdoctoral program in mathematics. Over the grant period, four interns were hired, two for the academic period 1988-90, one for 1989-91, and one for 1990-1992. Interns were paid by St. Olaf College to teach three courses per year (half the normal teaching load). The remaining half salary was paid by FIPSE and enabled interns to work closely with senior faculty mentors with the aims of becoming master classroom teachers and establishing research programs.

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Teaching Postdoctoral Positions in Mathematics

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Executive Summary

Project Summary:

In January 1988 St. Olaf College established a mentored teaching postdoctoral program in mathematics. Over the grant period, four interns were hired, two for the academic period 1988-90, one for 1989-91, and one for 1990-1992. Interns were paid by St. Olaf College to teach three courses per year (half the normal teaching load). The remaining half salary was paid by FIPSE and enabled interns to work closely with senior faculty mentors with the aims of becoming master classroom teachers and establishing research programs.

Project Background:

Traditional training in the education of Ph.D. mathematicians includes little if any formal work in learning how to teach. Indeed, the most talented graduate students of mathematics may be given fellowships or research grants which allow them to obtain the Ph.D. without ever having taught a class. Even graduate students who support their degree program with a teaching assistantship are supervised at a minimal level and often "teaching " consists of leading discussion sections. The result of this system is that new Ph.D.'s view teaching ability as marginally important to their profession.

Purpose:

The unadorned purpose of this project is to place new Ph.D. mathematicians in an environment within which they can become master classroom teachers and establish a personal research program.

Project Description:

With the help of funding from FIPSE, St. Olaf College established a mentored teaching postdoctoral program in January 1988. Over the grant period, four interns were hired; two for the academic period 1988-90, one for 1989-91, and one for 1990-1992. The final year budget of the fourth intern will be entirely supported by St. Olaf College. The FIPSE Postdoctoral Position, includes:

- teaching half-time ,
- providing sufficient funds for professional travel and library resources,
- creating a close professional relationship with a master classroom teacher,
- working in a department with an extraordinarily successful mathematics program,
- participating in and contributing to a rich professional environment.

Project Results:

The project had three main goals:

To show that a teaching postdoctoral program will be attractive to among the very best of new Ph.D. mathematicians.

To establish that a teaching postdoctoral position will be an effective method of developing master classroom teachers while promoting the development of research programs.

To show that such a program can be funded without unusual college/university resources.

The first two goals stated here have been achieved at a level far exceeding the original expectations of the proposers. The achievement of the third goal is not

clear at the writing of this report.

Conclusions:

1. A teaching postdoctoral program in mathematics at a liberal arts institution with a high quality mathematics program is very attractive to a large proportion of the very best of this country's new Ph.D. mathematicians.

2. A teaching postdoctoral program in mathematics at an institution committed to good teaching is very effective in creating master classroom teachers. The primary vehicles for this are a vibrant mentor-intern relationship and a lively teaching seminar.

3. Each intern learns a large amount of professional knowhow from a mentored teaching postdoctoral position in mathematics, and this process of learning both affirms and invigorates the existing faculty and staff.

4. Effective classroom teaching of mathematics entails a complicated symbiosis of personality, technique, philosophy, and a deep understanding of mathematics.

Teaching Postdoctoral Positions in Mathematics

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Project Report

Project Background

Traditional training in the education of Ph.D. mathematicians includes little if any formal work in learning how to teach. Indeed, the most talented graduate students of mathematics may be given fellowships or research grants which allow them to obtain the Ph.D. without ever having taught a class. Even graduate students who support their degree program with a teaching assistantship are supervised at a minimal level and often "teaching " consists of leading discussion sections. The result of this system is that new Ph.D.'s view teaching ability as marginally important to their profession. However, in November of 1986, the American Mathematics Society reported in The Notices that over eighty percent of new Ph.D.'s will take teaching jobs. With little or no experience or training in college teaching, they usually spend their first several years on the job learning how to teach. Few institutions have formal mechanisms by which new Ph.D.'s can improve their teaching and as a consequence the "learning to teach" is often done by trial and error. In fact, this "learning to teach" must take a back seat to establishing a research career or it is neglected altogether.

Undergraduate mathematics, especially the first two years, is the keystone to research in the natural sciences, economics and engineering, as well as computer science and mathematics itself. In its March 1986 report, the National Science Task Committee on Undergraduate Science and Engineering Education stated:

> *...attention has not yet been focused on the essential bridge between the*

schools and the national apparatus for research and development; that bridge is undergraduate education in mathematics, engineering and the sciences.

In his address to the annual joint meeting of the American Mathematics Society and the Mathematics Association of America in January of 1987, President Reagan's Science Advisor, Dr. William Graham said:

...Mathematics is commonly accepted as not only a discipline of its own and the universal language of science, but also the key enabling discipline....

Richard Feynman put it better:

I'm sorry some people find it difficult to learn math. If you want to understand nature, you must be conversant with the the language in which nature speaks to us.

There is a well documented and oft discussed need to present mathematics in an active and intellectually stimulating manner. The teaching of calculus, a fundamental course in undergraduate mathematics, has been termed a "national disgrace" by the president of the Mathematics Association of America. The current desperate state of mathematics education at the undergraduate level should come as no surprise. It is the direct consequence of the educational system which trains our Ph.D. mathematicians.

Project Description

In the October 1985 issue of The Notices of the American Mathematics Society, the Committee on the Status of the Profession stated:

...The academic mathematics community must, in the coming years, maintain the atmosphere and conditions in which [the] dual teacher-scholar role will be nurtured.

With the help of funding from FIPSE, St. Olaf College established a mentored teaching postdoctoral program in January 1988. Over the grant period, four interns were hired; two for the academic period 1988-90, one for 1989-91, and one for 1990-1992. The final year budget of the fourth intern will be entirely

supported by St. Olaf College.

The hiring of interns was done according to usual procedures. The American Mathematical Society publishes an employment journal and asks the academic community to publish every position normally filled with a Ph.D. mathematician in that journal. In addition to advertising in the Employment Information for the Mathematical Sciences[1], we placed several additional advertisements.[2] In addition to placing advertisements, flyers describing the postdoctoral positions were sent to over one hundred graduate departments of mathematics, phone inquiries were made, and two senior faculty members traveled to the Joint Meetings of the Mathematics Association of America and the American Mathematics Society in January. These were done each of the three years in which hiring was done. More than two hundred individuals applied in each of the three hiring periods.

During the spring of 1988 we brought five individuals to the St. Olaf Campus for interviews. We hired two of these top choices. During each of the following springs we interviewed three individuals on campus and hired one intern from among this group. The candidates were chosen on the basis of their potential to both benefit from this program and to make an impact in the mathematics community Specific criteria included:

1. interest in and talent for the undergraduate teaching of mathematics
2. referenced potential classroom teaching performance
3. promise of scholarship.

These three criteria were not taken lightly. We know as a faculty experienced in developing the teacher-scholar model, that successful applicants will be professionally responsible people who have the energy and commitment to develop both as excellent classroom teachers and important scholars. Evidence which we solicited from each candidate included:

1. a statement of professional goals and objectives which encompassed both the teaching and scholarship aspects of the applicant's anticipated career
2. letters attesting to the applicant's research ability and the quality of their current work.
3. letters attesting to the applicant's teaching ability or promise

[1] This advertisement can be found in the appendix

[2] These were placed in *the Notices of the American Mathematical Society, Focus, American Women in Mathematics Newsletter,* and *the Journal of the American Statistical Society.*

We also held telephone conversations with our top twenty (or so) candidates. While on campus, each candidate was asked to present two chalkboard talks. The first of these lectures was for an undergraduate audience at approximately the sophomore level and was fifty minutes long. The second presentation, for a faculty audience, consisted of a description of the applicant's research. It is perhaps important to note that this is an adaptation of the process which the Department of Mathematics uses in hiring all tenure track faculty and, as such, both the faculty and administration are experienced in carrying out these procedures.

The first two interns were Dr. Steven Benson from the University of Illinois and Dr. Timothy Hesterberg from Stanford University. Benson is an algebraist and Hesterberg is a mathematical statistician.

Clifton Corzatt served as a mentor for Benson while Theodore Vessey was Hesteberg's mentor. Professors Corzatt and Vessey were chosen as mentors because they are experienced teachers who are particularly sensitive to and interested in the problems of teaching mathematics to undergraduates. Further, they exhibit those characteristics of successful mentors described by E. Alleman in his dissertation Mentoring Relationships in Organizations, (University of Akron 1982)

> *...successful mentors are confident, secure, flexible, altruistic, warm and caring, sensitive to proteges needs, and they trust their proteges.*

The training of mentors consisted of being assigned a student observer, having two classes video-taped, meeting four times with Professor Mary Ellen Ross, a faculty consultant for the improvement of teaching, and reading selected materials on mentoring. The student observer program at St. Olaf College has been in place for ten years. Student observers are selected and trained to observe classroom teaching and provide feedback for the faculty member. They attend all class meetings of the course throughout the term and meet weekly with the faculty member to discuss strengths and weaknesses.

During the first year of the program[3]:

1. A weekly teaching seminar was established.
2. Student observers were trained and daily attended both mentor and intern classes.

[3] In this we followed the proposed activities quite closely.

3. Classes of both mentors and interns were videotaped and these tapes viewed and discussed.
4. Interns were encouraged to prepare their dissertation work for professional publication.
5. Dr. Milton Cox, Vice Provost from Miami University in Ohio visited the department to give a preliminary evaluation of the program.[4]

An additional activity which we should have anticipated (but didn't!) was:

6. The interns played a major role in recruiting our third intern.

The third intern was Dr. Karen Saxe from the University of Oregon. Saxe is a functional analyst. Upon returning from sabbatical leave, Paul Humke both replaced Corzatt as grant director and became Saxe's mentor. The activities listed above were continued during the third year. Changes included.[5]

1a. The teaching seminar was opened to the entire department (including two other new faculty and their mentors). Average attendance was twelve per week.
b. Two books were read and discussed.[6]
c. A conference was planned and carried out.[7]
2. Videotaping was extended to every participant in the teaching seminar.
3. Both Benson and Hesterberg completed one paper outside their dissertation work. Humke and Saxe attended the weekly Real Analysis Seminar at the University of Minnesota in which Saxe gave one lecture.
6. Again, all three interns played a critical role in recruiting and hiring the fourth intern.

In December, Bob Borrelli, Chair of the Department of Mathematics at Harvey

4 Dr. Cox's report can be found in the appendix.

5 These numbers refer to those topics listed above

6 L.A. Braskamp, D.C. Brandenburg, and J.C. Ory, *Evaluating Teachig Effectiveness: A Practical Guide*, Sage, 1984

Wilbert J. McKeachie, Teaching Tips: A Guidebook for the Beginning College Teacher, D.C. Heath and Co., 1986

Peter Seldin, *Changing Practices in Faculty Evaluation*, Jossey-Bass, 1987

7 The St. Olaf Conference on the New Professor of Mathematics. Conference materials can be found in the appendix.

Mudd College and Armond Spencer of the Department of Mathematics at SUNY Potsdam visited our department for three days. These departments were chosen because they are well known for their high quality undergraduate mathematics programs. Information about the St. Olaf mathematics program including our postdoctoral program was sent to both Borrelli and Spencer prior to their visit. We received and distributed similar data from each of Borrelli and Spencer about their programs. During the visit, we held an all department colloquium in which faculty and students first heard descriptions of the Harvey Mudd and Potsdam programs and then asked questions. Some highlights of our discussions are below.

- These three programs are different from others throughout the country, each graduating almost ten times the national average of mathematics majors each year.

- This is the first time anyone investigated similarities between these programs.

- Although there are differences between the programs, some aspects are similar and these are also among the more distinctive aspects of these programs.

- The important question is "*why are these programs so successful?*" All of us felt we understood some ingredients of an answer after the visit[8]..

In addition, four meetings of interns and mentors were devoted to discussing the current job market with particular focus on those institutions advertising that year. Although the job market was particularly tight in 1990, both Benson and Hesterberg received many offers. Importantly, these offers came from both high quality, liberal arts colleges and research institutions. The attention the interns attracted was most encouraging to everyone involved in the program. In the end, both interns took a first choice position; Benson at the Santa Clara University and Hesterberg at Franklin and Marshall College.

The three interns (Benson, Hesterberg, and Saxe) authored an article about our program which was published as an editorial response in the Notices of the American Mathematical Society last spring. [9]

[8] Reports of Borrelli and Spencer can be found in the appendix.

[9] This article can be found in the appendix.

Our conference, The St. Olaf Conference on the New Professor of Mathematics, was held from June 5-7, 1990 at St. Olaf College.[10] Salient features included:

- Participant Profile
  a. Participation was by invitation only.
  b. Participants were about equally divided from high quality liberal arts colleges and high quality research universities.
  c. About two-thirds of participants were professors of mathematics and of these about half were established mathematicians, half relatively recent Ph.D.'s.
  d. About one-third of the participants were graduate students of mathematics in at least the third year of their program.

- During the program, descriptions were given of the job of a professional mathematician at both research universities and liberal arts colleges. These were then compared, contrasted, and critiqued.

- Criteria for professional success were compared and contrasted. Differences between written criteria, advertised criteria, and actual criteria for professional evaluation were bluntly analyzed in both the research university and liberal arts settings.

- Young faculty and graduate students hosted a session to discuss their motivation in pursuing a career as academic mathematicians.

I can't help editorializing that this conference was an absolutely fascinating experience. We all left knowing something we did not know when we came. Fascinating.

- Our presenters were all hand-picked and are well known dedicated mathematicians. They included :

Amy Davidow, PEW Postdoctoral Fellow, University of Chicago
Bert Fristedt, Department of Mathematics, University of Minnesota
Don Lewis, Chair, Department of Mathematics, University of Michigan
Peter Olver, Department of Mathematics, University of Minnesota
Harriet Pollatcek, Chair, Department of Mathematics, Mount Holyoke College
Bruce Resnik, Department of Mathematics, University of Illinois
Amy Davidow, PEW Postdoctoral Fellow, University of Chicago

[10] A conference invitation, description, and program are included in the appendix.

Steve Benson, Tim Hesterberg, Ockle Johnson, Karen Saxe, FIPSE Postdoctoral Fellows, St. Olaf College

- Discussion, both formal and informal, about the current training of graduate students and about the professional expectations of young faculty was blunt and and deeply disturbing.

During the third year of the program, we hired our fourth intern, Dr. Ockle Johnson of Brown University; Johnson is a geometer. The program will continue next year with St. Olaf College assuming full financial responsibility. Once again, and in the face of a very difficult job market, our intern, Karen Saxe, was in high demand. Recently, Saxe accepted a position at Macalester College.

In the remainder of this report, I'll restate each of the program goals and then comment on our progress toward those goals.

Discussion of Project Goals

GOAL #1 Develop high quality teaching skills in teaching interns

-Conduct interviews with interns twice a semester to monitor satisfaction with the various teaching program activities, identify barriers and unexpected outcomes, and document to what extent planned activities have taken place.

-Develop special course evaluations for teaching of mathematics to monitor quality of intern's teaching during the two year period. Use information as guidance for improvement. Compare early and final ratings of interns. Compare global ratings of interns with other new St. Olaf faculty (statistics available from standard forms used at St. Olaf).

Comments: There is no question that this mentored teaching postdoctoral program has improved teaching skills. And improvement was not restricted to the interns! Superficial changes included technique improvement (e.g. writing larger on the blackboard or estimating the length of an exam). Substantial changes included the deepening of individual teaching philosophies, (e.g., personal answers to such questions as why does one teach this material, what's difficult about this material

and why is it difficult?) Such philosophies of teaching mathematics have been forged in the heat of debate about how to deal with specific students and specific student difficulties. One of the interesting areas of similarity between the Harvey Mudd, Potsdam, and St. Olaf program is that we all said we:

1. *teach students (in contrast to teaching mathematics)*
2. *teach students the power of mathematics to illuminate difficult ideas.*

That is, teaching is not about things, but primarily about people. But, it involves enabling each individual student to understand powerful and difficult ideas. There is no algorithm for doing this nor can there be. But, teaching mathematics can, like any craft, be learned.

We have used standard student evaluations each term and have used these to design new strategies for teaching particular classes. However, the real growth of teachers involved in the program occurred at a level deeper than the scope of current student evaluations.

GOAL #2 Promote research activity of interns

-Obtain from interviews the satisfaction of interns with their research activity, e.g., quantity of time, availability of other resources including journals and opportunity for interaction with other scholars in the field.

-Gather and compare information on research activity and satisfaction of accepted and rejected applicant finalists at the end of each two year internship and again three years after completion of internship .

Comments: We found that dissertation advisors had not discussed publication procedures with our interns. We, therefore, first discussed the basics of how to write a paper for publication, how to select a journal to send it to, what to expect from the referees and editor, and what to do in the face of rejection. Interns worked hard on their research credentials, all have published their dissertation results, and have gone on to complete additional papers. Saxe and Humke have been able to collaborate on one paper and are presently working on a second. The interns all have their research careers well under way, have established networks of more senior researchers, and continue to be productive researchers.

Quantitatively, Benson had two papers published and one additional submitted, Hesterberg, three published and one submitted, and Saxe (thus far) has two papers published and two additional submitted at this writing. Johnson has submitted one paper thus far (five months into his first year).

We did not follow the research careers of accepted and rejected applicant finalists.

GOAL #3 Enhance and facilitate the socialization of interns to their profession

-Through a questionnaire administered at the end of the two year internship, obtain information from accepted and rejected finalists who are teaching, their perception of the ease with which they made the transition from graduate school to teaching, to what extent they understood and adhered to the values and reward system of the teaching profession, how quickly they felt a part of the institution, the extent to which they thought they had gained insight into the institution's structure, culture, politics, personalities, etc.

Comments: Although we were unable to closely follow the socialization of our applicants, we were able to discuss socialization as part of our conference. Typically, no formal attention or support is given to new faculty at either liberal arts colleges or research universities. Subsequent to our conference, several schools began mentoring programs. These included Kalamazoo College and St. Cloud State University.

GOAL #4 Develop Ph.D. mathematicians with interest in teaching into future leaders in the profession

-Gather information through questionnaires about career pattern, professional achievements and goals from both accepted and rejected applicant finalists, at the end of each two year internship and again three years after the completion of the internship.

Comments: It is simply too early to tell if this goal will be met. I believe it will.

GOAL #5 Enhance vitality of mentors

-Gather information from interviews with mentors at the end of their two year participation about their perceptions of the effects of the program on their vitality, and the extent to which the experience served to challenge, stimulate and encourage creativity in their teaching and research; the extent to which they derived satisfaction from the helping process, and the degree to which the program assisted them to better understand and appreciate the professional contributions and accomplishments of their own careers.

Comments: Mentors agree on several points. Second, being a mentor takes a whole lot of work, but first, being a mentor is very rewarding, affirming, and enlightening. All three of the mentors who have worked with our program so far feel that their teaching has improved in measurable ways. The mentors not only visited the intern classes, but each others, and in this way learned to copy successful techniques of their peers.

Outcomes, Present and Predicted

The mathematics community has relied on prestigious post-doctoral programs to develop promising young Ph.D.'s into outstanding research mathematicians. These programs, which are usually housed at major research universities, give the new Ph.D. a chance to work closely with an outstanding research mathematician for one or two years before seeking full-time employment in the academic world. These programs usually ignore the fact that full-time employment in the academic world almost always has a teaching component and for the new Ph.D. this component is frequently the most significant part of the job.

Our primary intended outcome is to serve the dual needs of the potential teacher-scholar. We have started a program which serves as a bridge between the graduate schools and the permanent job which the new Ph.D. is likely to fill. Instead of the new Ph.D. focusing only on establishing a research career, we suggest that it is of equal importance to establish themselves as master teachers. This teaching post-doctoral program gives equal weight to each of these components. A program like ours has the potential to be attractive to the recent Ph.D. and to the institutions which eventually hire them. This has certainly been our experience.

There are several other outcomes which we believe will result from our program, but it is too early to know for certain. First, we expect that the interns who have completed our program will become leaders of the mathematics community. We expect them to become leaders in their departments and outstanding teachers who will attract students to mathematics. We believe that our program has helped to socialize these new Ph.D.s to the profession. It is often assumed that the new Ph.D. will automatically know how to relate to peers and to students. These are difficult lessons that are usually learned by trial and error. A mentoring program like ours provides an excellent opportunity to begin focusing on these issues in a caring nonthreatening environment. The department of mathematics housing such a program will also benefit directly. The mentors will have an opportunity to evaluate their own teaching and improve it in significant ways. The St. Olaf Mathematics Department has been characterized by its vitality, but this vitality must constantly be renewed. The participants in our program have been revitalized by the opportunity to get involved in the careers of these young mathematicians. Any department instituting such a program will also benefit greatly by having young Ph.D.'s in mathematics bringing their ideas and research to the campus on a regular basis.

Conclusions:

1. A teaching postdoctoral program in mathematics at a liberal arts institution with a high quality mathematics program is very attractive to a large proportion of the very best of this country's new Ph.D. mathematicians.

2. A teaching postdoctoral program in mathematics at an institution committed to good teaching is very effective in creating master classroom teachers. The primary vehicles for this are a vibrant mentor-intern relationship and a lively teaching seminar.

3. Each intern learns a large amount of professional knowhow from a mentored teaching postdoctoral position in mathematics, and this process of learning both affirms and invigorates the existing faculty and staff.

4. Effective classroom teaching of mathematics entails a complicated symbiosis of personality, technique, philosophy, and a deep understanding of mathematics.

5. Much of the release time built into this program is critical to the success. of the program. This makes the program expensive and somewhat difficult to

establish within usual college/university funding patterns. A minimal program should include

- About $750 per year travel money for each intern
- A teaching load of no more that four courses per year for each intern.
- An established, well attended and lively teaching seminar.
- Some recognition (i.e. either release time or money) for mentors.

Appendices

Recruiting Materials
Consultants Reports
Conference Materials

SAINT OLAF COLLEGE
NORTHFIELD, MINNESOTA 55057

One two-year postdoctoral position, partially funded by the Fund for the Improvement of Post-Secondary Education. This position is half time teaching (three courses/year) and half time research. Unlike most postdoctoral positions, there will be a strong emphasis upon developing the teaching aspect of an academic career through a mentored internship. This position is allotted generous research and professional travel budgets. Salary: $31,500. For new or recent Ph.D.'s only. A complete application should include three letters of recommendation, an official graduate school transcript, a statement concerning your professional goals, and three self-addressed mailing labels. Write to Professor Paul D. Humke, Mathematics Department, St. Olaf College, Northfield, MN 55057. St. Olaf is an Equal Opportunity Affirmative Action employer.

ST. OLAF COLLEGE NORTHFIELD, MINNESOTA 55057

March 24, 1991

Dear Applicant:

Thank you for your inquiry about the mentored postdoctoral position at St. Olaf College. I've enclosed a short description of the program with this note, but if you would like more details, please feel free to call or e-mail. To apply for this position, please send a curriculum vitae, a statement of your professional goals, and arrange for three letters of recommendation to be sent to me.

Sincerely yours,

Paul D. Humke
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Enc:

THE FUND FOR THE IMPROVEMENT OF POST-SECONDARY EDUCATION
FROM ST. OLAF COLLEGE

Abstract

Traditional education of Ph.D. mathematicians includes little if any formal work in learning to teach. The result of this system is that new Ph.D.'s view teaching ability as marginally important to their profession even though most of them will seek teaching positions upon completion of their degrees.

Undergraduate mathematics is the keystone to research in the natural sciences, economics and engineering, as well as computer science and mathematics itself. The extent to which undergraduate teaching is deficient is the extent to which scientific and mathematical research will be less than it should be.

St. Olaf College has established mentored teaching postdoctoral positions each year for three years. These positions, for new Ph.D.'s in mathematics, provide mentored internships in the teaching of mathematics and also provide the interns an opportunity to become established as research mathematicians.

The program benefits the young mathematician who is beginning a career. Consequently, the whole mathematics community will benefit, particularly those who will teach with these interns and the students who will be in their classes.

St. Olaf College is particularly well qualified to carry out this experimental program. The mathematics department has a strong commitment to excellence in teaching at the undergraduate level and has been nationally recognized for the strength and breadth of its program and curriculum.

We consider each new recipient of the Ph.D. in mathematics as part of a scarce national resource. The mathematics community and each new Ph.D. have invested much time and energy in the process of completing that degree. Our plan is a way to use that investment more effectively. We believe that the success of this program will serve as a model and an incentive to other colleges and universities.

ST. OLAF COLLEGE NORTHFIELD, MINNESOTA 55057

March 24, 1991

University of Notre Dame
Department of Mathematics
Notre Dame, IN 46556

Dear Ms. Smith:

Thank you for your application to the Post-Doctoral position at St. Olaf College. Although several of us will be at the Louisville meeting, we will not be participating in the employment register there. However, we are very interested in your application and would like to visit with you in Louisville if that proves convenient for you.

I'll arrive on Wednesday, at about noon, and will be available most of the day on Thursday, Friday, and Saturday. Please leave a note for me in the mail area when you arrive, or , if you prefer, schedule a time by calling Donna at 507-663-3113. I'm looking forward to meeting you in Louisville.

Sincerely yours,

Paul D. Humke
507-645-6440(home)
507-663-3113(St. Olaf)

The FIPSE Project
Post-Doctoral Teaching Program
Department of Mathematics
St. Olaf College

Consultant's Report

Milton D. Cox
Associate Provost for
Teaching Effectiveness Programs
Miami University
and
Project Coordinator
Ohio Board of Regents FIPSE Project
Undergraduate Education Enhancement Program
Ohio Board of Regents

May 26, 1989

Consultant's Report
FIPSE Project: Postdoctoral Teaching Internships in Mathematics
St. Olaf College
Milton D. Cox

The project is off to a good start.

During my visit I confirmed that the members of the mathematics department at St. Olaf College -- faculty and students -- have a strong commitment to excellence in teaching and undergraduate education. I found vitality with respect to interest, enthusiasm and critical thought regarding mathematics teaching, learning and curriculum. Thus the environment for this FIPSE project is excellent: the mathematics department at St. Olaf College is an ideal place for a new PhD in mathematics to learn and be inspired about teaching and mathematics community.

Let me address early progress toward meeting some of the goals (intended outcomes) of the postdoctoral teaching program in mathematics (p. 12 of the FIPSE proposal).

Goal 1 is to "Develop high quality teaching skills in the teaching interns." Let me begin by commenting on some of the early efforts at achieving this goal.

I found the student observers to be excellent. This is the first time I have encountered a program where students work with instructors for an entire semester to improve teaching. In my interviews with intern Tim Hesterberg and his student observer, Becky, and with intern Steve Benson and his student observer, Bob, I was impressed with the students' professional and dedicated approach and the impact that the students have had on each professors' teaching. Regarding Dr. Tim Hesterberg, Becky builds his confidence regarding his teaching. While Tim feels that he has not made much progress this first semester, Becky says that she has seen much improvement and points that out to him. Intern Steve Benson indicates that his interaction with his student observer, Bob, is one of the best experiences of his internship. Bob has given many helpful tips, for example, ways to reduce time spent answering homework questions (Steve has reduced his time from 40 to 20 minutes).

The videotaping of each intern's teaching has taken place once. Tim has looked at his but has not shared it with Becky or his mentor, Ted Vessey. Tim has not yet felt the impact of the videotaping. Steve feels the videotaping has been a helpful experience; it confirmed what his student observer, Bob, had said. I recommend that videotaping have an increased role next year. Laurie Richlin, Director of the Teaching Assistant Development Program at the University of California, Riverside, uses videotaping in her work teaching TA's to become better teachers; she has developed a protocol that you may wish to use. Also, Joe Lowman, Psychology, University of North Carolina at Chapel Hill, and Ted Fenton, Co-Director of the Teaching Center, Carnegie Mellon University, are both successful with videotaping to improve teaching. You may wish to invite one of them to visit.

Class visits by the mentors to the interns' classes have been helpful, and I recommend that more be done next year. Steve indicates that his mentor, Cliff Corzatt, has visited his class, and Tim indicates Ted Vessey, his mentor, has visited him twice and that he would like more visits. Tim indicates that the student observers bring the students' helpful perspective, but that only a mathematics teacher can bring the "best approach to teaching the mathematics". Perhaps the visits could be more regular and structured, say at least biweekly.

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Class visits by the interns to other faculty in mathematics should be continued. The interns have noticed how the instructors' personalities color the way they teach; recognizing this variability is important. During an interns' second year, it would be helpful to visit some classes taught by instructors outside the mathematics department. In addition to finding wider perspectives on teaching, this would also enhance the socialization of interns to their profession, which is Goal 3.

The mentorship part of the relationship impacts all 5 goals. This is a delicate and extremely important enterprise. While Ted's contact with Tim has been valuable, Ted has been quite busy and so Tim has on occasion turned to who do have much time to give. Both mentors, [illegible]. Next year, select mentors that Goal 5, "enhance vitality of mentors," is being met. The weekly meetings (seminar and mentor/intern) have given them an opportunity to talk and think about teaching, and that has been great.

The teaching seminar on linear algebra has been helpful for the interns as they plan for taking that course next year. Some other faculty in the department may be disappointed in the choice of topic (not interesting since they are familiar with teaching linear algebra). For an intern's second year, I would suggest expanding the seminar to wider topics, for example, William Perry's stages of intellectual and ethical development of students during the college years, Blythe Clinchy's (et al) Womens Ways of Knowing, and Pat Cross and Tom Angelo's Classroom Assessment Techniques.

Concerning Goal 2, "promoting research activity of interns," I think that more care needs to be taken. While Steve seems to feel he is getting more results on his thesis topic, Tim has not yet started a research program; he has not yet journeyed to the University of Minnesota. He indicates that he needs some software before he can start. Tim is totally consumed by his teaching, spending all his extra time preparing for teaching calculus. This is not healthy, even though this is the first time he has taught calculus.

With respect to Goal 3, "enhancing and facillitating the socialization of interns to their profession," I suggest that interns attend meetings such as the local MAA section meetings (or equivalent statistics or SIAM meetings). Also, attendance at either Lilly Conference on College Teaching would be valuable.

Concerning your FIPSE project evaluation, I was very impressed with St. Olaf's internal evaluator, Alice Thomas, Director of Educational Research. Her preliminary and ongoing work will provide helpful feedback for evaluating the FIPSE project.

In conclusion, I think there is good progress and potential for meeting the five program goals. Some fine tuning is needed, but this is within the spirit and resources of the participants.

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DEPARTMENT
OF
MATHEMATICS
714 / 621-8023

January 19, 1990

Professor Paul D. Humke
Department of Mathematics
St. Olaf College
Northfield, MN 55057

Dear Paul,

Enclosed is a report of my visit. Sorry it took so long but the start up of the second semester here was unusually hectic for me.

Again, many thanks for inviting me. I appreciate the time and attention that you and your colleagues devoted to our visit. I also enjoyed the opportunity to talk to Armond Spencer. I look forward to hosting a visit here for you and some of your colleagues in the year future. Give my best to everyone and thank them for me for the time that they spent with us.

Sincerely,

Robert L. Borrelli

RB:ssc

Report of Visit
to the
Mathematics Department, St. Olaf's College
November 30-December 2, 1989

The purpose of this report is to describe some of my experiences and observations during a 3-day visit to the Mathematics Department at St. Olaf College, Northfield, MN. Professor Armond Spencer (Potsdam College, SUNY), and I were both invited to St. Olaf to share and compare the respective mathematics programs of Harvey Mudd, Potsdam and St. Olaf for the purpose of learning more about the components of successful math programs. This activity was envisioned as being especially helpful for the three current FIPSE visitors, Tim Hesterberg, Steve Benson and Karen Saxe, as well as an opportunity for Professor Spenser and I to learn first-hand about the FIPSE program at St. Olaf.

As indicated above Professor Spenser and I spent three whole days at St. Olaf's with full agendas each day. My observations and remarks appear below:

- I spent some 4 or 5 hours total with *Tim Hesterberg* and *Steve Benson* (two FIPSE visiting faculty) and had lunch with *Karen Saxe* (the other FIPSE visitor) who all teach half-time. All of them appear to be thoroughly enjoying the experience of teaching in the extremely supportive environment which exists in the mathematics department. They appreciate the many teaching/learning opportunities which go on regularly in the mathematics department. [For example, the *Mathematics Practicum* is a month-long inter-semester program which gives students and faculty an opportunity to work on open-ended industrial problems in a small team-like environment – Tim will be involved in one such problem in January 1990.] All-in-all I found that the "mentoring" concept in the hands of a department whose teaching craft is at a very high level provides an excellent vehicle for exposing young faculty to successful and effective teaching.
- *Bobbi Helling* (=Director, Math Teaching/Learning Center) told us about the many opportunities faculty and students have to try out new ideas in teaching and learning mathematics. One idea that especially impressed me was the *Student-Observer Program* where student assistants are placed in classrooms to, in effect, act as eyes and ears for <u>both</u> faculty and students throughout the learning process (incidentally, this is an idea that I hope to use at Harvey Mudd College someday).
- At the Colloquium (Thursdays at 2 p.m.) both Armond Spenser and I gave 15-minute overviews of our respective mathematics programs to a general audience of students, faculty, and visiting faculty; the remainder of the hour was devoted to a question-ans-answer period. One fact emerged very clearly: Although our programs have evolved

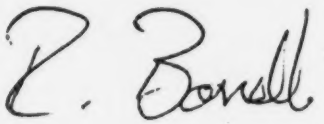
in ways appropriate to our own institutions we all have a deep commitment to the needs of each individual student – our students really believe that we care about them as individuals. Another common thread is that enthusiasm and love for mathematics is effectively communicated to students – albeit in many diverse ways. There were, of course come differences: Potsdam and St. Olaf mathematics major programs tend to channel students into a relatively small number of "major" courses whereas Harvey Mudd math major programs have much more flexibility.

- At the *Education Seminar* (Thursdays at 3:30 p.m.) Professor Spenser and I participated in a general discussion with the St. Olaf mathematics faculty (and visitors) on details of departmental operations and relations of our departments with other departments and the college at large. There were many obvious differences due to the fact that HMC is part of a consortium, Potsdam is part of a public state system and St. Olaf is a small private liberal arts college.
- I had individual conferences with *Cliff Corzatt*, (who will Chair the math department next year), *Paul Humke* (our host), and *Ted Vessey* (present math department Chair) in which we shared our experiences in managing innovation at our respective institutions. It was very enlightening to learn first-hand about how challenges and opportunities are dealt with in a large active department. St. Olaf is very fortunate to have such talented and sensitive administrators among its mathematics faculty.
- I had a pleasant chat with *Steve McKelvey* who directs the Practicum program of St. Olaf. Steve reminded me that a graduate of St. Olaf, Tom Savage, who received his Ph.D. at the Claremont Graduate School, was responsible for bringing the Claremont Mathematics Clinic concept to St. Olaf which eventually evolved into the Practicum. The Practicum is in good hands – I'm glad to see it prospering.
- Meetings with *Judy Cederberg* (who is responsible for placement) and *Peter Bolstad* (who heads the tutoring program) were very informative. I was impressed with the high professional level of these operations.
- I spent a very pleasant afternoon with *Paul Zorn* and *Arnie Ostebee* learning about their considerable efforts to bring computers and computation into the educational process in a very creative and imaginative way. I only wish I had more time to get into the details.
- A meeting with new young faculty members, *Margaret Reese* and *Laura Chihara* revealed that they were happy and productive in the St. Olaf environment.
- *Kathy Trier*, a Master Teacher from a nearby school district, is involved in a program developed at St. Olaf to provide a bridge between high school advanced placed mathematics courses and the college environment. Kathy is enthusiastic about the program and recommends it very highly.
- I learned a great deal from *Arthur Seebach* and *Loren Larson* about computers and

computation at St. Olaf as well as about the Putnam Exam and other problem-solving activities. As with everything else I learned about the St. Olaf math program, this activity is highly organized and very well run.

Summary and Conclusion

Paul Humke did an excellent job in organizing the 3-day visit described briefly above – I feel that I know the mathematics program at St. Olaf quite well now. The mathematics department at St. Olaf has a superb dedicated faculty which works well together, and is creative and talented. The department has clearly attained a high level in the craft of teaching mathematics. I recommend strongly that the FIPSE program be continued, and even expanded. The need for effective math faculty has never been greater, and institutions like St. Olaf with a truly exemplary teaching tradition have a great deal to offer young faculty who are about to embark on a career in teaching math, especially at an undergraduate level. Some might even say that institutions like St. Olaf have an obligation to share those elements of their highly successful program with math departments and faculty of other institutions. Unfortunately training and mentoring have some expenses associated with them if they are to be effective. Hopefully, St. Olaf will be able to find support for this program long into the future.



January 19, 1990

A REPORT OF MY VISIT TO ST. OLAF COLLEGE

From November 30 thru December 2, I had the pleasure of visiting the Mathematics Department at St. Olaf College in Northfield, Minnesota. My primary observation is that the program could easily be the model for Liberal Arts mathematics programs. I can easily say that, since the similarities between the mathematics programs at St. Olaf and at my home institution, Potsdam College of The State University of New York, are striking. The programs, the students, the college missions, even the campus atmosphere and settings are similar. The importance placed on music is shared by the two colleges. The dominant feature of both mathematics programs is the belief that mathematics can be studied by a large number of students provided they are given the proper supportive environment the primary ingredient of which is helping students gain self-confidence and dignity. Both programs seem to put concern for student welfare well above concern for curricular matters. We also have very similar attitudes about the proper definition of scholarly pursuit, and the proper role of mathematical research.

Much has been written about the best way to prepare teachers for careers in four year colleges like ours. A popular suggestion is that we should have two different types of Ph. D. programs, one for prospective faculty of four year colleges, and one for prospective faculty of Ph.D. granting institutions. I believe that this idea is dead wrong. Although continued production of publishable mathematics might not be a principle activity of faculty at four year colleges, it is essential that such faculty members have done significant research and have developed the confidence and self assurance that they can do such research, i.e. that they are mathematicians in the fullest sense of the word. Having so arrived, a person can then go into a life of teaching. I believe that the natural outcome of limiting the expectation of high achievement for prospective teachers may cause such teachers to unconsciously limit the aspirations of their students.

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The forgoing explains why I see the Post-Doc program at St. Olaf so valuable for prospective college teachers. I have observed for some years now, young Ph.D's joining our faculty, being given three or four courses to teach in a setting where teaching is considered very important, struggling to establish themselves in this new setting, and to write those first two papers from their dissertations. I think that the time available to the young people at St. Olaf is very important. This gives them time to work hard on their teaching, and to pursue the research projects begun in graduate school. I at first wondered about the temporary nature of the program, though now I believe that it is desirable. Relief from reappointment pressure should allow the new faculty member a chance to concentrate on the job at hand.

At first I was a little apprehensive about the mentoring program, wondering if the Post-Doctoral Fellows would feel that they were not quite full fledged departmental citizens. After discussing this situation at some length with the current Fellows, I did not sense any such feeling at all. Indeed, what I found was that they appreciated the help given by a senior faculty member and really liked the opportunity to learn about teaching from some outstanding journeymen of the trade. Here in my own department, I and many of my colleagues of course, invite each new faculty member to "stop by if you have any questions". I am convinced now that a more formal mentoring relationship between the new faculty members and some senior members should be established. The new faculty we have this year have said that they would have valued such an arrangement.

Another aspect of the St. Olaf program I think is outstanding, though simple (but aren't a lot of outstanding ideas simple?) is the Education Seminar. To formalize to some degree the coffee room discussions about teaching and to hear concerns and ideas freely expressed and considered probably will help new faculty as much as anything else we can do for them.

There is a real difference between what "teaching" means in most graduate schools and what it means in a liberal arts setting. We expect our young colleagues to figure out what the difference is by themselves, and while they are doing that we are deciding on whether or not to reappoint them. Somehow we must do better.

I believe that the new Ph.D.'s who go through a program like the Post-Doc program at St. Olaf will make the transition from graduate school to college teacher much more smoothly than those who simply go directly into a regular position. I am currently chairing the staffing committee in my department, and given the background and training of most of our applicants, the need for some sort of transition program is apparent.

The "crisis" in Mathematics Education we are reading so much about these days will not be solved by curricular changes, nor by technologically improved delivery systems but by dedicated teachers who believe that the most important aspect of teaching is the maintenance of a supportive learning environment. If the environment I saw at St. Olaf was widespread, there would be no crisis. The Post-Doc program is one way to help. If we can find some way to export the attitude at St. Olaf even more widely, we will have taken a major step toward a solution of the crisis.

Armond E. Spencer
Professor
Mathematics Department
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The St. Olaf Conference
on
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Preparing Graduate Students & New Faculty for Successful Careers in Mathematics.

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- Mentoring new faculty
- The role of graduate schools
- Postdoctoral fellowships
- The St. Olaf/FIPSE and PEW programs

The conference will take place June 8-10 at St. Olaf College and participation is by invitation. A grant from the Fund for the Improvement of Postsecondary Education will enable us to provide dormatory housing and board for all participants. Transportation from the Minneapolis-St. Paul International Airport will be provided at various times on Thursday and Sunday afternoons. To reserve a place at the conference please return the enclosed reservation form by May 1. If neither you nor a representative of your department can attend please let us know so that we can invite another department. For additional information contact:

Professor Margaret Reese
Department of Mathematics
St. Olaf College
Northfield, MN 55057
reese@stolaf.edu
507-663-3113

ST. OLAF COLLEGE NORTHFIELD, MINNESOTA 55057

April 11, 1990

Dear Colleague:

On June 8-10, 1990, St. Olaf College will host a conference focusing on the important first years in the career of a professor of mathematics. This conference is supported by the Fund for the Improvement of Post-Secondary Education (FIPSE). The conference will begin with a banquet on Friday evening, June 8, followed by an address by Bruce Reznick (University of Illinois). The last session will end at noon on Sunday, June 10.

I am pleased to invite you or a representative from your department to participate. (Because funding is limited, participation in the conference is by invitation only.) Although we cannot support travel expenses, we shall provide room and board for the weekend. Local housing information can be found on the enclosed conference participation form. A schedule is also enclosed.

Please let me know as soon as possible whether or not you or a representative from your department is planning to attend by either returning the enclosed form or by using e-mail. A position is reserved for you until the first week of May.

I hope to see you in June.

Sincerely,

Margaret Reese

Margaret Reese
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Northfield is located about 40 miles south of the Minneapolis-St. Paul International Airport. The conference has arranged for airport transportation to and from Northfield at 4:00 p.m. and 5:00 p.m. on Friday, June 8 and at 12:30 p.m. and 3:00 p.m. on Sunday, June 10. The roundtrip cost of this transportation is $20.00. If you are interested in this mode of transportation, please arrange your flights accordingly. If this is impossible, please let us know, as special arrangements are possible. In addition, the airport is served by Jefferson Bus Lines which leaves the airport at 6:05 p.m. daily arriving in Northfield at about 7:00 (in time for the Friday night banquet). The current cost of a one-way bus ticket is $7. Taxi and limousine service is also available at somewhat inflated rates.

All invited conference participants will be provided room (doubles) and board on the St. Olaf campus. If you would like to request a room with a specific conference participant, please indicate your preference on the form below. In addition, be sure that this person also requests you as their roommate.

In order to help our planning, please return the form as soon as possible. We will contact you later about your travel plans.

(Cut here and save the top portion for future reference)

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St. Olaf/FIPSE Conference Participation Form

check one { ___Our department will be unable to send a representative to the conference
___I wish to attend the St. Olaf/FIPSE Summer Conference

Name:

Address:

I would like to share a room with _____.

e-mail address:

phone number(s):

Please return this form by **May 1** to:

Margaret L. Reese
St. Olaf Conference
St. Olaf College
Northfield, MN 55057
electronic mail: **reese@stolaf.edu**

and third as examples of how the view from the top often gives us a distorted picture, and is not the only one that should be considered. (Fortunately, it appears that other members of the Committee have taken the broader view, and the plan is still alive.)

With over 19,000 working mathematicians unfunded in any way and, therefore, eligible at best for grants regarded as second-class, it is no wonder our profession is in trouble. From the position of most hard-working mathematicians trying to do research with little institutional funding and no hope of first-class support, a travel grant program is quite attractive. When (deservedly) well-funded mathematicians who probably have little idea of what life is like for most of the membership of the AMS decide that such grants would constitute welfare, they seriously undermine the integrity of their constituency. Let mathematicians make those decisions for themselves. Application is not, after all, mandatory.

The community already has one example of a successful travel grant program that is functioning on a much smaller scale than the AMS program would, but has in the past year provided partial support for twenty-five women with no other outside funding to attend research conferences in their fields. The Association for Women in Mathematics has a three-year grant from the NSF to award travel grants to women; while we have had to turn away more applicants than we would like, this disappointment is far outweighed by the pleasure of supporting these research efforts. We've had no complaints that those women who have received the grants feel like second-class citizens. The grants have not been difficult to administer, and the panels, meeting via conference call, have found the work rewarding. The response to this program is much greater than we expected, and demonstrates that (women) mathematicians need travel funds and are willing to apply for them. If the AMS can convince the NSF to fund such a program without jeopardizing the basic research effort, I sincerely hope that the Science Policy Committee will see this as a most worthwhile program, affecting a wide range of mathematicians, and deserving of its most enthusiastic endorsement.

Rhonda J. Hughes
Past-President, AWM
Bryn Mawr College
(Received November 27, 1989)

Mentoring and the Mathematics Postdoc

As three 'mentored' postdocs, we were excited to read William Jaco's statement on the health of the postdoctoral program in mathematics. In particular, he points out that the mathematics community, in contrast to related disciplines, does not view the postdoc 'as a continuing education/training period' and that no active component of mentoring is generally found in a postdoc program. We feel fortunate to be postdocs at St. Olaf College where mentoring *is* an active component of the program. The situation at St. Olaf is perhaps the exception more than the rule, but we hope that this innovative program will serve as a model and an incentive to other colleges and universities.

The aim of this program is to help us develop as researchers *and* as teachers. Like postdocs in more traditional programs, we receive financial support for research (in the form of half of the normal teaching load, supported by a grant from the Fund for the Improvement of Post-Secondary Education), allowing us to expand our individual research programs. Unlike most postdocs, we have mentors who help us, primarily by facilitating our development as teachers. We meet weekly to discuss classroom issues, local and national curriculum reform trends, and the maintenance of a vibrant mathematics program. Other features of the program, designed to help with teaching, include student observers and videotaping. St. Olaf is well qualified to carry out such a program; the department has a broad curriculum as well as a very strong commitment to excellence in teaching, and the proximity to (and cooperation of) the University of Minnesota make a research library and seminars easily accessible.

We believe that mentoring should play a role for more postdocs and that mentored postdoc programs make sense at a wide range of institutions (at four year schools as well as at research universities). Nearly all mathematicians teach, and our discipline can only benefit if its new members are effective and stimulating teachers. A mentored postdoc program can also be used to attract Ph.D.'s from allied areas (such as statistics, computer science and operations research), who often have limited teaching experience, to teach in our undergraduate mathematics programs.

We hope to see a cooperation between undergraduate institutions, research universities, professional societies and funding agencies that will lead to a revitalization of the national mathematics postdoc program.

Steve Benson
Tim Hesterberg
Karen Saxe
St. Olaf College
(Received November 16, 1989)

Feminist Critiques of Science

The recent critiques of the "Feminist Critiques of Science" in the July/August 1989 issue of *Notices* prompt me to record a few observations.

1) In this era of indiscriminate articulation mathematicians are indeed among the most vulnerable and conspicuous targets for pent up resentments let loose in the guise of sociological studies. Vulnerable, because communication with Mathematics is so delicate and intimate that it requires peace and privacy, whether pursued by a team or in isolation. Mystifying publicity only